

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 11-121585

(43)Date of publication of application : 30.04.1999

(51)Int.Cl.

H01L 21/68
B65G 49/07

(21)Application number : 09-285291

(71)Applicant : OLYMPUS OPTICAL CO LTD

(22)Date of filing : 17.10.1997

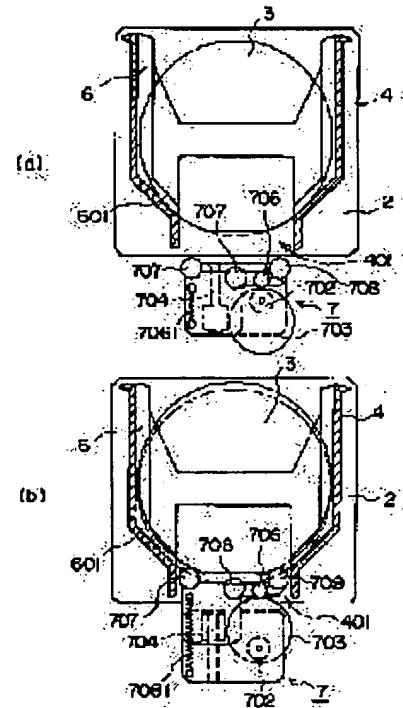
(72)Inventor : KATO TOMOO
KIMURA KEIJI

(54) WAFER CARRIER

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a wafer carrier which can surely prevent the breakdowns of wafers at carrying of wafers.

SOLUTION: This wafer carrier is one which accommodates a wafer 3, which its edge inserted in the slot groove 6 within a wafer cassette 4 and is provided with a wafer push-out mechanism 7, corresponding to a push operation hole 401 at the flank on a side opposite to the wafer take-in and -out part, for taking a wafer in and out of the wafer cassette 4. In this wafer push-out mechanism 7, a plurality of push pins 707, 708, and 709 planted on a sub space 705 are pushed against the edge of the wafer 3 for pushing out the wafer 3 by a specified quantity to the side of a wafer-in and -out part, by rectilinearly shifting the sub base along a direct-acting guide 704 through a disc-like cam 703 through the rotation of a motor 702.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

Copyright (C); 1998,2003 Japan Patent Office

*** NOTICES ***

JPO and NCIPI are not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

CLAIMS**[Claim(s)]**

[Claim 1] The wafer transport device characterized by forming the wafer extrusion means of a specified quantity push **** sake for said wafer in the wafer receipts-and-payments section which takes the wafer with which it is conveyed in the wafer cassette which inserts and holds a wafer periphery in a slot slot in and out, and the opposite side at said wafer receipts-and-payments section side.

[Claim 2] A wafer extrusion means is a wafer transport device according to claim 1 characterized by being pressed against the wafer periphery where it is conveyed in said wafer cassette, and having a specified quantity push **** migration means for this wafer in said wafer receipts-and-payments section side while a straight-line drive is carried out by a driving means and this driving means.

[Claim 3] A wafer extrusion means is a wafer transport device according to claim 1 characterized by being pressed against all the wafer peripheries in said wafer cassette, putting these wafers in block to said wafer receipts-and-payments section side, and having a specified quantity push **** migration means while a straight-line drive is carried out by manual operation.

[Translation done.]

* NOTICES *

JPO and NCIPI are not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the wafer transport device which carries out drawing conveyance of the wafer from a wafer cassette.

[0002]

[Description of the Prior Art] To the wafer transport device which carries out drawing conveyance, conventionally a wafer from a wafer cassette As shown in drawing 7, the wafer cassette 4 which held many wafers 3 in the direction of a laminating is laid on the cassette base 2 whose vertical movement was enabled by the elevator device section 1. If the cassette base 2 is dropped to a predetermined location by the elevator device section 1, the wafer 3 conveyed in the wafer cassette 4 by the sensor which is not illustrated is detected and the conveyance wafer 3 is detected in the case of conveyance initiation Only predetermined distance raises the cassette base 2 by the elevator device section 1, and the conveyance arm 5 is inserted in the conveyance wafer 3 bottom. Furthermore, only predetermined distance drops the cassette base 2 by the elevator device section 1, a wafer 3 is adsorbed by the conveyance arm 5, a wafer 3 is sampled from the wafer cassette 4, and there are some which were supplied to the following down stream processing.

[0003] By the way, the wafer cassette 4 used for such a wafer transport device forms two or more slot slots 6 in accordance with the internal side attachment wall, and he is trying to hold a wafer 3 in the wafer cassette 4 in the level condition by inserting wafer 3 periphery in these slot slot 6, as shown in drawing 8 (a).

[0004] In this case, although the slot slot 6 makes the cross section trapezoidal shape and the touch area with a wafer 3 is made to become as small as possible So that a wafer's 3 dedropping [the wafer cassette 4 to] may not be found when a wafer 3 is held in the wafer cassette 4 since a wafer 3 is disc-like As shown in drawing 8 (b), circular or the surroundings lump section 601 which makes it the trapezoidal shape and turns behind the wafer cassette 4 which meets the periphery of a wafer 3 in the slot slot 6 is formed.

[0005]

[Problem(s) to be Solved by the Invention] Although it carries in the condition of having contained in the cassette case for the insurance of a wafer 3, and protection against dust when carrying the wafer 3 held in such a wafer cassette 4, at however, this time Within a cassette case, since it is carried where a wafer 3 is stood so that wafer cassette 4 front face may turn up that is, when the wafer 3 is ground thinly, wafer 3 periphery may eat into the surroundings lump section 601 to wafer cassette 4 back of the slot slot 6.

[0006] Although the criterion of the thickness of a wafer 3 is about 0.6mm, it is in the condition held in the wafer cassette 4 and wafer 3 periphery hardly ate into the slot slot 6 until now, the rear face is thinly ground more often to about 0.1mm, and wafer 3 periphery sometimes eats the thickness of a wafer 3 into the slot slot 6 plentifully recently.

[0007] For this reason, the wafer cassette 4 in the condition that wafer 3 periphery ate into such a slot slot 6 is set on the cassette base 2 of the wafer transport device mentioned above. Since it is as wafer 3 periphery ate into the slot slot 6 of the wafer cassette 4 when wafer conveyance is performed, when it is going to lift a wafer 3 with the conveyance arm 5 in order to take out this wafer 3, a wafer 3 is bent compulsorily and there is a problem of producing wafer breakage.

[0008] Although it puts into the exclusive cassette case for transportation which is not illustrated and he is trying to convey, such a cassette case for transportation forms the slot slot where width of face is still narrower, and it prevents the shake of the wafer 3 at the time of transportation, and he is trying to maintain the safety of a wafer 3 by inserting wafer 3 periphery in this slot slot on the other hand, so that a wafer 3 may not be damaged when a wafer 3 moves long distances, such as interplant.

[0009] However, while an adsorption error may arise since the level condition of the wafer 3 within a cassette case is not held when it is going to perform wafer conveyance after transportation with such a cassette case for transportation,

since the width of face of a slot slot is narrow, wafer 3 periphery may interfere in a slot slot only by lifting a wafer 3 slightly at the time of wafer conveyance, and wafer breakage may be caused. For this reason, in the case of the cassette case for transportation, it had to move to the wafer cassette for conveyance mentioned above, and on the occasion of this moving, dust adhered to the wafer 3 and there was a problem of damaging a wafer by activity mistake. This invention was made in view of the above-mentioned situation, and aims at offering the wafer transport device which can prevent certainly the wafer breakage at the time of wafer conveyance.

[0010]

[Means for Solving the Problem] He is trying for invention according to claim 1 to form the wafer extrusion means of a specified quantity push **** sake for said wafer in the wafer receipts-and-payments section and the opposite side take the wafer with which it is conveyed in the wafer cassette which inserts and holds a wafer periphery in a slot slot in and out of which at said wafer receipts-and-payments section side.

[0011] In the claim 1 publication, invention according to claim 2 is pressed against the wafer periphery where it is conveyed in said wafer cassette, and has the specified quantity push **** migration means for this wafer in said wafer receipts-and-payments section side while the straight-line drive of the wafer extrusion means is carried out by a driving means and this driving means.

[0012] In the claim 1 publication, invention according to claim 3 is pressed against all the wafer peripheries in said wafer cassette, bundles up these wafers to said wafer receipts-and-payments section side, and has the specified quantity push **** migration means while the straight-line drive of the wafer extrusion means is carried out by manual operation.

[0013] Consequently, according to invention according to claim 1, interlocking to the slot slot of the wafer cassette of a wafer periphery etc. can be canceled, and a wafer can be extruded to a wafer receipts-and-payments section side with a right posture.

[0014] since according to invention according to claim 2 interlocking to the slot slot of the wafer cassette of a wafer periphery etc. can be canceled automatically and it can extrude to a wafer receipts-and-payments section side by driving a driving means -- ** -- wafer appearance [like] -- carrying out -- a means -- wafer conveyance -- the stable activity which does not have wafer breakage in the case of wafer conveyance is realizable by incorporating in process.

[0015] A tact time can be shortened, while a configuration is easy and being able to do it advantageously in cost, since all the wafers in a wafer cassette can be collectively extruded to a wafer receipts-and-payments section side by moving a migration means by manual operation according to invention according to claim 3.

[0016]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained according to a drawing. (Gestalt of the 1st operation) In this case, the general drawing of a wafer transport device shall be the same as that of drawing 7 mentioned above, and shall use this drawing here.

[0017] Thus, the wafer extruder style as shown in drawing 1 R> 1 (a) and (b) is combined with the constituted wafer transport device. In this case, the wafer cassette 4 laid on the cassette base 2 whose vertical movement was enabled by the elevator device section 1 forms two or more slot slots 6 in an internal side attachment wall, and he is trying to hold a wafer 3 in the wafer cassette 4 in the level condition by inserting wafer 3 periphery in these slot slot 6. Moreover, this slot slot 6 so that a wafer's 3 dedropping [the wafer cassette 4 to] may not be found when a wafer 3 is held in the wafer cassette 4 since a wafer 3 is disc-like Circular or a such wafer cassette 4 which forms the surroundings lump section 601 which makes it trapezoidal shape and turns behind the wafer cassette 4 which meets the periphery of a wafer 3 the slot slot 6 It had the push actuation hole 401 in the wafer receipts-and-payments section which the wafer 3 to convey takes, and the opposite side, i.e., wafer cassette 4 rear face, this push actuation hole 401 was countered, and the wafer extruder style 7 is arranged.

[0018] This wafer extruder style 7 formed the motor 702 in the base 701, as shown in drawing 2 (a) and (b), it penetrated the base 701 for the revolving shaft 7021 of this motor 702, a projection is made the opposite side of the base 701, and made eccentricity of the disc-like cam 703 to this revolving shaft 7021, and is prepared. The drive of the subbase 705 in the direction which met the direct-acting guide 704 is enabled by making the cam follower 706 which formed the subbase 705 in the base 701 through the direct-acting guide 704, and was prepared in this subbase 705 contact disc-like cam 703 periphery, and rotating the disc-like cam 703 by the motor 702.

[0019] In this case, he forms a spring 7061 between the bases 701 at the subbase 705, and is trying for the cam follower 706 of the subbase 705 to always contact disc-like cam 703 periphery. Moreover, the migration direction of the subbase 705 which met the direct-acting guide 704 has become in the direction which intersects perpendicularly to wafer cassette 4 front face which extrudes the wafer 3 of the wafer cassette 4 straightly, and can do it.

[0020] The push pins 707, 708, and 709 of plurality (the example of illustration 3) are implanted in the front location of

the subbase 705 by the physical relationship which touches the periphery of a wafer 3. In this case, when the push pins 707 and 709 are arranged at spacing larger than the cage hula of a wafer 3 and a cage hula exists among these push pins 707 and 709, wafer 3 periphery can be contacted ranging over a cage hula. Moreover, when, as for the push pin 708, the cage hula of a wafer 3 does not exist among the push pins 707 and 709, wherever the contact to wafer 3 periphery may be attained with the push pins 707 and 709 and the cage hula location of a wafer 3 may be located within the wafer cassette 4 by these push pins 707, 708, and 709, only the same movement magnitude extrudes a wafer 3 and can be made to do it.

[0021] When the resin body 7074 of a push pin is formed in the shaft 7072 fixed to the subbase 705 with the securing bolt 7071 pivotable through bearing 7073 as the push pin 707 is shown in drawing 3, and a wafer 3 is pushed by the body 7074 of a push pin, the body 7074 of a push pin is made for wafer 3 edge not to eat into the body 7074 of a push pin by rotation here. It constitutes like [pins / 708 and 709 / other / push] the push pin 707.

[0022] Next, actuation of the gestalt of the operation constituted in this way is explained. In this case, if the wafer cassette 4 is laid on the cassette base 2 whose vertical movement was enabled by the elevator device section 1, it switches on [which is not illustrated] and wafer conveyance initiation is directed, the flow shown in drawing 4 will be performed.

[0023] First, the cassette base 2 descends to a conveyance starting position by the elevator device section 1 at step 401. And the sensor which is not illustrated detects the conveyance wafer 3 in the wafer cassette 4 at step 402. Here, when the conveyance wafer 3 is not detected, it is step 403, and the same actuation is repeated until it drops the wafer cassette 4 further and the conveyance wafer 3 is detected.

[0024] And if the conveyance wafer 3 is detected at step 402, only a constant rate U will increase the cassette base 2 by the elevator device section 1 at step 404. Although the wafer extruder style 7 is started from this condition, the wafer extruder style 7 before starting is standing by in the location estranged from the push actuation hole 401 of wafer cassette 4 rear face as shown in drawing 1 R>1 (a) so that the push pins 707, 708, and 709 may not interfere in the wafer 3 in the wafer cassette 4.

[0025] And if the disc-like cam 703 which started the wafer extruder style 7, rotated the motor 702, was made to carry out eccentricity to a revolving shaft 7021, and was prepared at step 405 is rotated As the subbase 705 resists the hauling force of a spring 7061 through a cam follower 706, straight-line migration is carried out along with the direct-acting guide 704 in the push actuation hole 401 direction of wafer cassette 4 rear face and it is shown in drawing 1 (b) The push pins 707, 708, and 709 on the subbase 705 are pressed against wafer 3 periphery. Even if the periphery of a wafer 3 is eating into the slot slot 6 of the wafer cassette 4 by this, it is canceled of the slot slot 6 and a wafer 3 can be extruded to a wafer receipts-and-payments section side.

[0026] In this case, when, as for the push pins 707 and 709, the cage hula of a wafer 3 exists among these push pins 707 and 709, Wafer 3 periphery is contacted ranging over a cage hula. Moreover, the push pin 708 When the cage hula of a wafer 3 does not exist among the push pins 707 and 709, wherever it may come to contact wafer 3 periphery with the push pins 707 and 709 and the cage hula location of a wafer 3 may be located within the wafer cassette 4 Only the same amount can extrude a wafer 3 by these push pins 707, 708, and 709, and it can carry out.

[0027] Then, if it is step 406, a motor 702 is rotated further and the disc-like cam 703 is rotated through a revolving shaft 7021 As straight-line migration is carried out in the direction which the subbase 705 estranges from the push actuation hole 401 of the wafer cassette 4 along with the direct-acting guide 704 according to the hauling force of a spring 7061 through a cam follower 706 and it is shown in drawing 1 (a) The push pins 707, 708, and 709 on the subbase 705 are returned to the position in readiness distant from the wafer 3.

[0028] From this condition, at step 407, the conveyance arm 5 is inserted in the conveyance wafer 3 bottom, only predetermined distance lowers the cassette base 2 by the elevator device section 1 at step 408, and the wafer 3 by the conveyance arm 5 is adsorbed by step 409.

[0029] And by step 410, a wafer 3 is extracted from the wafer cassette 4 by the conveyance arm 5, and processing according to the application of equipment is performed at step 411. After termination of processing, while inserting the conveyance arm 5 in the same location as the time of the ejection of a wafer 3 at step 412, adsorption by the conveyance arm 5 is canceled.

[0030] Only the movement magnitude D lowered in order that the conveyance arm 5 might adsorb a wafer 3 raises the cassette base 2 at step 413, and a wafer 3 is delivered all over the slot slot 6 of the wafer cassette 4. And at step 414 The conveyance arm 5 is moved to a position in readiness, and conveyance processing of one wafer 3 is ended, and hereafter, it comes to repeat the same processing with having mentioned above until it judges processing termination about all the wafers in the wafer cassette 4 at step 415.

[0031] Therefore, if it does in this way, it will be what inserts wafer 3 periphery in the slot slot 6 in the wafer cassette 4,

and was held in it. Corresponding to the wafer receipts-and-payments section which takes the wafer of the wafer cassette 4 in and out, and the push actuation hole 401 of an opposite side side, form the wafer extruder style 7, and it sets to this wafer extruder style 7. By carrying out straight-line migration of the subbase 705 along with the direct-acting guide 704 through the disc-like cam 703 by rotation of a motor 702 two or more push pins 707, 708, and 709 implanted in the subbase 705 press against wafer 3 periphery -- having -- a wafer 3 -- a wafer receipts-and-payments section side -- specified quantity push *****, since it was made like Even if the periphery of a wafer 3 is eating into the slot slot 6 of the wafer cassette 4 It can be canceled of the slot slot 6, a wafer 3 can be extruded to a wafer receipts-and-payments section side, and the wafer breakage which results from wafer 3 periphery remaining eating into the slot slot 6 as for this can be prevented certainly.

[0032] Moreover, if a motor 702 is driven, since interlocking to the slot slot 6 of the wafer cassette 4 of wafer 3 periphery etc. can be canceled automatically and it can extrude to a wafer receipts-and-payments section side, the stable activity which does not have wafer breakage in the case of wafer conveyance is realizable by incorporating such a wafer extruder style 7 into a wafer conveyance process.

(Gestalt of the 2nd operation) Although three push pins 707, 708, and 709 have been arranged with the gestalt of the 1st operation according to the physical relationship which touches the periphery of a wafer 3 so that only the same amount may extrude a wafer 3 and can do it wherever the cage hula location of a wafer 3 might be located within the wafer cassette 4 Depending on a process, the cage hula location of the wafer 3 in the wafer cassette 4 has aligned, or the case of the notch instead of a cage hula exists like a 8 inch wafer. [0033] So, the gestalt of this 2nd operation shows the wafer transport device optimal in such a case. Drawing 5 shows the outline configuration of the 2nd of the gestalt of operation of this invention, and gives the same sign to the same part as drawing 1.

[0034] In this case, the wafer extruder style 7 which counters the push actuation hole 401 of wafer cassette 4 rear face, and is prepared arranges one push pin 710 to the subbase 705 prepared in the base 701 movable through the direct-acting guide 704. When not contacting a cage hula to the location of 3' in a wafer 3, this push pin 710 extrudes a wafer 3, and has come to be able to do it to the location of 3", when the contact to wafer 3 periphery in the wafer cassette 4 is attained so that the wafer 3 of the wafer cassette 4 may be extruded straightly and may be made, and the push pin 710 contacts the cage hula of a wafer 3.

[0035] Thus, even if constituted, after it detected the conveyance wafer 3 in the wafer cassette 4 and only the constant rate has increased the cassette base 2 by the elevator device section 1 If the wafer extruder style 7 is started, a motor 702 is rotated and the disc-like cam 703 which was made to carry out eccentricity to a revolving shaft 7021, and was prepared is rotated through a cam follower 706, the subbase 705 resists the hauling force of a spring 7061, and carries out straight-line migration along with the direct-acting guide 704 in the actuation hole 401 direction of wafer cassette 4 rear face -- having -- ***** -- the push pin 710 on the subbase 705 is pressed against wafer 3 periphery like. Even if the periphery of a wafer 3 is eating into the slot slot 6 of the wafer cassette 4 by this, it is canceled of the slot slot 6 and a wafer 3 can be extruded to a wafer receipts-and-payments section side.

[0036] In this case, when the push pin 710 contacts the cage hula of a wafer 3, a wafer 3 is extruded to the location of 3', and when not contacting a cage hula, a wafer 3 will be extruded to the location of 3".

[0037] Therefore, even if such, the same effectiveness as the gestalt of the 1st operation is expectable, and further, compared with the gestalt of the 1st operation, a processing part and components mark can be lessened and can be made in cost and advantageous.

(Gestalt of the 3rd operation) With the gestalt of the 1st and the 2nd operation, although he is trying to extrude one wafer 3 in the wafer cassette 4 at a time, in other test equipment, the elevator device section 1 may not be formed, but the conveyance arm 5 may move up and down to serve also as the elevator device section 1, and a wafer 3 may be extracted.

[0038] So, the gestalt of this 3rd operation shows the optimal wafer transport device for such equipment. Drawing 6 (a) and (b) show the outline configuration of the 3rd of the gestalt of operation of this invention, and give the same sign to the same part as drawing 1.

[0039] In this case, the wafer extruder style 8 which counters the push actuation hole 401 of wafer cassette 4 rear face, and is prepared has stood straight and formed the column 802 in the base 801. And the direct-acting guides 803 and 803 were formed in the vertical location of this column 802, respectively, and the subbase 804 is formed free [an attitude] to the push actuation hole 401 of wafer cassette 4 rear face through these direct-acting guides 803 and 803.

[0040] The wafer was carried out to the edge corresponding to wafer cassette 4 rear face of the subbase 804, and the pin 805 is formed in it. A wafer is carried out and a pin 805 moves in this direction that intersects perpendicularly to wafer cassette 4 front face in the wafer cassette 4 which extrudes a wafer 3 straightly and can do it in a package altogether by advance to the push actuation hole 401 direction of wafer cassette 4 rear face of the subbase 804.

[0041] In this case, sufficient stroke which minded the subbase 804 by the direct-acting guides 803 and 803 and which extrudes certainly and is possible even if the successive range of a pin 805 has the cage hula location of a wafer 3 in which location in the wafer cassette 4 by carrying out a wafer is secured, and it has not come to extrude a wafer 3 too much with the stopper which is not illustrated.

[0042] The spring 806 is formed between the subbase 804 and a column 802. This spring 806 is for always retreating the position in readiness which opened the subbase 804 from the push actuation hole 401 of wafer cassette 4 rear face. Moreover, when the subbase 804 is pulled by the spring 806, the subbase 804 and the direct-acting guide 803 fall out with the stopper which is not illustrated.

[0043] In addition, 807 is a handle for being attached in the subbase 804 and carrying out advance migration of the subbase 804 in the push actuation hole 401 direction of wafer cassette 4 rear face.

[0044] In such a configuration, if the wafer cassette 4 resists the hauling force of a spring 806 in the subbase 804 on the cassette base 2 by an operator doing push actuation of the handle 807 from an installation **** condition and makes it move forward in the push actuation hole 401 direction of wafer cassette 4 rear face, a wafer will be carried out and a pin 805 will be pressed against coincidence in all wafer 3 peripheries in the wafer cassette 4 with advance of the subbase 804. Even if the wafer 3 which is eating into the slot slot 6 of the wafer cassette 4 exists by this, these wafers 3 are also canceled of the slot slot 6, and can be extruded to a wafer receipts-and-payments section side.

[0045] Moreover, if push actuation of a handle 807 is canceled of this condition, the subbase 804 will retreat with a spring 806 to the position in readiness opened from the push actuation hole 401 of wafer cassette 4 rear face.

[0046] If it does in this way, therefore, the wafer extruder style 8 Since a wafer is carried out by push actuation of the handle 807 by the operator and it was made to carry out advance migration of the pin 805 Since can simplify the whole wafer extruder style 8 configuration further, it can do advantageously in cost, and a wafer is carried out further, and all the wafers 3 in the wafer cassette 4 are put in block by advance migration, and a pin 805 is extruded and is made, a tact time can also be shortened.

[0047]

[Effect of the Invention] Since according to this invention interlocking to the slot slot of the wafer cassette of a wafer periphery etc. can be canceled and a wafer can be extruded to a wafer receipts-and-payments section side with a right posture as stated above, a wafer periphery can remain eating into a slot slot, or a wafer can prevent certainly the wafer breakage which results from not being held at a level condition.

[0048] Moreover, if a driving means is driven, since interlocking to the slot slot of the wafer cassette of a wafer periphery etc. can be canceled automatically and it can extrude to a wafer receipts-and-payments section side, the stable activity which does not have wafer breakage in the case of wafer conveyance is realizable by incorporating such a wafer extrusion means into a wafer conveyance process.

[0049] Furthermore, a tact time can be shortened, while a configuration is easy and being able to do it advantageously in cost, since all the wafers in a wafer cassette can be collectively extruded to a wafer receipts-and-payments section side by moving a migration means by manual operation.

[Translation done.]

*** NOTICES ***

JPO and NCIPI are not responsible for any
damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

TECHNICAL FIELD

[Field of the Invention] This invention relates to the wafer transport device which carries out drawing conveyance of the wafer from a wafer cassette.

[Translation done.]

* NOTICES *

JPO and NCIPI are not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

PRIOR ART

[Description of the Prior Art] To the wafer transport device which carries out drawing conveyance, conventionally a wafer from a wafer cassette As shown in drawing 7, the wafer cassette 4 which held many wafers 3 in the direction of a laminating is laid on the cassette base 2 whose vertical movement was enabled by the elevator device section 1. If the cassette base 2 is dropped to a predetermined location by the elevator device section 1, the wafer 3 conveyed in the wafer cassette 4 by the sensor which is not illustrated is detected and the conveyance wafer 3 is detected in the case of conveyance initiation Only predetermined distance raises the cassette base 2 by the elevator device section 1, and the conveyance arm 5 is inserted in the conveyance wafer 3 bottom. Furthermore, only predetermined distance drops the cassette base 2 by the elevator device section 1, a wafer 3 is adsorbed by the conveyance arm 5, a wafer 3 is sampled from the wafer cassette 4, and there are some which were supplied to the following down stream processing.

[0003] By the way, the wafer cassette 4 used for such a wafer transport device forms two or more slot slots 6 in accordance with the internal side attachment wall, and he is trying to hold a wafer 3 in the wafer cassette 4 in the level condition by inserting wafer 3 periphery in these slot slot 6, as shown in drawing 8 (a).

[0004] In this case, although the slot slot 6 makes the cross section trapezoidal shape and the touch area with a wafer 3 is made to become as small as possible So that a wafer's 3 dedropping [the wafer cassette 4 to] may not be found when a wafer 3 is held in the wafer cassette 4 since a wafer 3 is disc-like As shown in drawing 8 (b), circular or the surroundings lump section 601 which makes it the trapezoidal shape and turns behind the wafer cassette 4 which meets the periphery of a wafer 3 in the slot slot 6 is formed.

[Translation done.]

*** NOTICES ***

JPO and NCIPI are not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

EFFECT OF THE INVENTION

[Effect of the Invention] Since according to this invention interlocking to the slot slot of the wafer cassette of a wafer periphery etc. can be canceled and a wafer can be extruded to a wafer receipts-and-payments section side with a right posture as stated above, a wafer periphery can remain eating into a slot slot, or a wafer can prevent certainly the wafer breakage which results from not being held at a level condition.

[0048] Moreover, if a driving means is driven, since interlocking to the slot slot of the wafer cassette of a wafer periphery etc. can be canceled automatically and it can extrude to a wafer receipts-and-payments section side, the stable activity which does not have wafer breakage in the case of wafer conveyance is realizable by incorporating such a wafer extrusion means into a wafer conveyance process.

[0049] Furthermore, a tact time can be shortened, while a configuration is easy and being able to do it advantageously in cost, since all the wafers in a wafer cassette can be collectively extruded to a wafer receipts-and-payments section side by moving a migration means by manual operation.

[Translation done.]

*** NOTICES ***

JPO and NCIPI are not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] Although it carries in the condition of having contained in the cassette case for the insurance of a wafer 3, and protection against dust when carrying the wafer 3 held in such a wafer cassette 4, at however, this time Within a cassette case, since it is carried where a wafer 3 is stood so that wafer cassette 4 front face may turn up that is, when the wafer 3 is ground thinly, wafer 3 periphery may eat into the surroundings lump section 601 to wafer cassette 4 back of the slot slot 6.

[0006] Although the criterion of the thickness of a wafer 3 is about 0.6mm, it is in the condition held in the wafer cassette 4 and wafer 3 periphery hardly ate into the slot slot 6 until now, the rear face is thinly ground more often to about 0.1mm, and wafer 3 periphery sometimes eats the thickness of a wafer 3 into the slot slot 6 plentifully recently.

[0007] For this reason, the wafer cassette 4 in the condition that wafer 3 periphery ate into such a slot slot 6 is set on the cassette base 2 of the wafer transport device mentioned above. Since it is as wafer 3 periphery ate into the slot slot 6 of the wafer cassette 4 when wafer conveyance is performed, when it is going to lift a wafer 3 with the conveyance arm 5 in order to take out this wafer 3, a wafer 3 is bent compulsorily and there is a problem of producing wafer breakage.

[0008] Although it puts into the exclusive cassette case for transportation which is not illustrated and he is trying to convey, such a cassette case for transportation forms the slot slot where width of face is still narrower, and it prevents the shake of the wafer 3 at the time of transportation, and he is trying to maintain the safety of a wafer 3 by inserting wafer 3 periphery in this slot slot on the other hand, so that a wafer 3 may not be damaged when a wafer 3 moves long distances, such as interplant.

[0009] However, while an adsorption error may arise since the level condition of the wafer 3 within a cassette case is not held when it is going to perform wafer conveyance after transportation with such a cassette case for transportation, since the width of face of a slot slot is narrow, wafer 3 periphery may interfere in a slot slot only by lifting a wafer 3 slightly at the time of wafer conveyance, and wafer breakage may be caused. For this reason, in the case of the cassette case for transportation, it had to move to the wafer cassette for conveyance mentioned above, and on the occasion of this moving, dust adhered to the wafer 3 and there was a problem of damaging a wafer by activity mistake. This invention was made in view of the above-mentioned situation, and aims at offering the wafer transport device which can prevent certainly the wafer breakage at the time of wafer conveyance.

[Translation done.]

* NOTICES *

JPO and NCIPI are not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

MEANS

[Means for Solving the Problem] He is trying for invention according to claim 1 to form the wafer extrusion means of a specified quantity push **** sake for said wafer in the wafer receipts-and-payments section and the opposite side take the wafer with which it is conveyed in the wafer cassette which inserts and holds a wafer periphery in a slot slot in and out of which at said wafer receipts-and-payments section side.

[0011] In the claim 1 publication, invention according to claim 2 is pressed against the wafer periphery where it is conveyed in said wafer cassette, and has the specified quantity push **** migration means for this wafer in said wafer receipts-and-payments section side while the straight-line drive of the wafer extrusion means is carried out by a driving means and this driving means.

[0012] In the claim 1 publication, invention according to claim 3 is pressed against all the wafer peripheries in said wafer cassette, bundles up these wafers to said wafer receipts-and-payments section side, and has the specified quantity push **** migration means while the straight-line drive of the wafer extrusion means is carried out by manual operation.

[0013] Consequently, according to invention according to claim 1, interlocking to the slot slot of the wafer cassette of a wafer periphery etc. can be canceled, and a wafer can be extruded to a wafer receipts-and-payments section side with a right posture.

[0014] since according to invention according to claim 2 interlocking to the slot slot of the wafer cassette of a wafer periphery etc. can be canceled automatically and it can extrude to a wafer receipts-and-payments section side by driving a driving means -- ** -- wafer appearance [like] -- carrying out -- a means -- wafer conveyance -- the stable activity which does not have wafer breakage in the case of wafer conveyance is realizable by incorporating in process.

[0015] A tact time can be shortened, while a configuration is easy and being able to do it advantageously in cost, since all the wafers in a wafer cassette can be collectively extruded to a wafer receipts-and-payments section side by moving a migration means by manual operation according to invention according to claim 3.

[0016]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained according to a drawing. (Gestalt of the 1st operation) In this case, the general drawing of a wafer transport device shall be the same as that of drawing 7 mentioned above, and shall use this drawing here.

[0017] Thus, the wafer extruder style as shown in drawing 1 R> 1 (a) and (b) is combined with the constituted wafer transport device. In this case, the wafer cassette 4 laid on the cassette base 2 whose vertical movement was enabled by the elevator device section 1 forms two or more slot slots 6 in an internal side attachment wall, and he is trying to hold a wafer 3 in the wafer cassette 4 in the level condition by inserting wafer 3 periphery in these slot slot 6. Moreover, this slot slot 6 so that a wafer's 3 dedropping [the wafer cassette 4 to] may not be found when a wafer 3 is held in the wafer cassette 4 since a wafer 3 is disc-like Circular or a such wafer cassette 4 which forms the surroundings lump section 601 which makes it trapezoidal shape and turns behind the wafer cassette 4 which meets the periphery of a wafer 3 the slot slot 6 It had the push actuation hole 401 in the wafer receipts-and-payments section which the wafer 3 to convey takes, and the opposite side, i.e., wafer cassette 4 rear face, this push actuation hole 401 was countered, and the wafer extruder style 7 is arranged.

[0018] This wafer extruder style 7 formed the motor 702 in the base 701, as shown in drawing 2 (a) and (b), it penetrated the base 701 for the revolving shaft 7021 of this motor 702, a projection is made the opposite side of the base 701, and made eccentricity of the disc-like cam 703 to this revolving shaft 7021, and is prepared. The drive of the subbase 705 in the direction which met the direct-acting guide 704 is enabled by making the cam follower 706 which formed the subbase 705 in the base 701 through the direct-acting guide 704, and was prepared in this subbase 705 contact disc-like cam 703 periphery, and rotating the disc-like cam 703 by the motor 702.

[0019] In this case, he forms a spring 7061 between the bases 701 at the subbase 705, and is trying for the cam follower 706 of the subbase 705 to always contact disc-like cam 703 periphery. Moreover, the migration direction of the subbase 705 which met the direct-acting guide 704 has become in the direction which intersects perpendicularly to wafer cassette 4 front face which extrudes the wafer 3 of the wafer cassette 4 straightly, and can do it.

[0020] The push pins 707, 708, and 709 of plurality (the example of illustration 3) are implanted in the front location of the subbase 705 by the physical relationship which touches the periphery of a wafer 3. In this case, when the push pins 707 and 709 are arranged at spacing larger than the cage hula of a wafer 3 and a cage hula exists among these push pins 707 and 709, wafer 3 periphery can be contacted ranging over a cage hula. Moreover, when, as for the push pin 708, the cage hula of a wafer 3 does not exist among the push pins 707 and 709, Wherever the contact to wafer 3 periphery may be attained with the push pins 707 and 709 and the cage hula location of a wafer 3 may be located within the wafer cassette 4 by these push pins 707, 708, and 709, only the same movement magnitude extrudes a wafer 3 and can be made to do it.

[0021] When the resin body 7074 of a push pin is formed in the shaft 7072 fixed to the subbase 705 with the securing bolt 7071 pivotable through bearing 7073 as the push pin 707 is shown in drawing 3, and a wafer 3 is pushed by the body 7074 of a push pin, the body 7074 of a push pin is made for wafer 3 edge not to eat into the body 7074 of a push pin by rotation here. It constitutes like [pins / 708 and 709 / other / push] the push pin 707.

[0022] Next, actuation of the gestalt of the operation constituted in this way is explained. In this case, if the wafer cassette 4 is laid on the cassette base 2 whose vertical movement was enabled by the elevator device section 1, it switches on [which is not illustrated] and wafer conveyance initiation is directed, the flow shown in drawing 4 will be performed.

[0023] First, the cassette base 2 descends to a conveyance starting position by the elevator device section 1 at step 401. And the sensor which is not illustrated detects the conveyance wafer 3 in the wafer cassette 4 at step 402. Here, when the conveyance wafer 3 is not detected, it is step 403, and the same actuation is repeated until it drops the wafer cassette 4 further and the conveyance wafer 3 is detected.

[0024] And if the conveyance wafer 3 is detected at step 402, only a constant rate U will increase the cassette base 2 by the elevator device section 1 at step 404. Although the wafer extruder style 7 is started from this condition, the wafer extruder style 7 before starting is standing by in the location estranged from the push actuation hole 401 of wafer cassette 4 rear face as shown in drawing 1 R>1 (a) so that the push pins 707, 708, and 709 may not interfere in the wafer 3 in the wafer cassette 4.

[0025] And if the disc-like cam 703 which started the wafer extruder style 7, rotated the motor 702, was made to carry out eccentricity to a revolving shaft 7021, and was prepared at step 405 is rotated As the subbase 705 resists the hauling force of a spring 7061 through a cam follower 706, straight-line migration is carried out along with the direct-acting guide 704 in the push actuation hole 401 direction of wafer cassette 4 rear face and it is shown in drawing 1 (b) The push pins 707, 708, and 709 on the subbase 705 are pressed against wafer 3 periphery. Even if the periphery of a wafer 3 is eating into the slot slot 6 of the wafer cassette 4 by this, it is canceled of the slot slot 6 and a wafer 3 can be extruded to a wafer receipts-and-payments section side.

[0026] In this case, when, as for the push pins 707 and 709, the cage hula of a wafer 3 exists among these push pins 707 and 709, Wafer 3 periphery is contacted ranging over a cage hula. Moreover, the push pin 708 When the cage hula of a wafer 3 does not exist among the push pins 707 and 709, wherever it may come to contact wafer 3 periphery with the push pins 707 and 709 and the cage hula location of a wafer 3 may be located within the wafer cassette 4 Only the same amount can extrude a wafer 3 by these push pins 707, 708, and 709, and it can carry out.

[0027] Then, if it is step 406, a motor 702 is rotated further and the disc-like cam 703 is rotated through a revolving shaft 7021 As straight-line migration is carried out in the direction which the subbase 705 estranges from the push actuation hole 401 of the wafer cassette 4 along with the direct-acting guide 704 according to the hauling force of a spring 7061 through a cam follower 706 and it is shown in drawing 1 (a) The push pins 707, 708, and 709 on the subbase 705 are returned to the position in readiness distant from the wafer 3.

[0028] From this condition, at step 407, the conveyance arm 5 is inserted in the conveyance wafer 3 bottom, only predetermined distance lowers the cassette base 2 by the elevator device section 1 at step 408, and the wafer 3 by the conveyance arm 5 is adsorbed by step 409.

[0029] And by step 410, a wafer 3 is extracted from the wafer cassette 4 by the conveyance arm 5, and processing according to the application of equipment is performed at step 411. After termination of processing, while inserting the conveyance arm 5 in the same location as the time of the ejection of a wafer 3 at step 412, adsorption by the conveyance arm 5 is canceled.

[0030] Only the movement magnitude D lowered in order that the conveyance arm 5 might adsorb a wafer 3 raises the

cassette base 2 at step 413, and a wafer 3 is delivered all over the slot slot 6 of the wafer cassette 4. And at step 414 The conveyance arm 5 is moved to a position in readiness, and conveyance processing of one wafer 3 is ended, and hereafter, it comes to repeat the same processing with having mentioned above until it judges processing termination about all the wafers in the wafer cassette 4 at step 415.

[0031] Therefore, if it does in this way, it will be what inserts wafer 3 periphery in the slot slot 6 in the wafer cassette 4, and was held in it. Corresponding to the wafer receipts-and-payments section which takes the wafer of the wafer cassette 4 in and out, and the push actuation hole 401 of an opposite side side, form the wafer extruder style 7, and it sets to this wafer extruder style 7. By carrying out straight-line migration of the subbase 705 along with the direct-acting guide 704 through the disc-like cam 703 by rotation of a motor 702 two or more push pins 707, 708, and 709 implanted in the subbase 705 press against wafer 3 periphery -- having -- a wafer 3 -- a wafer receipts-and-payments section side -- specified quantity push *****, since it was made like Even if the periphery of a wafer 3 is eating into the slot slot 6 of the wafer cassette 4 It can be canceled of the slot slot 6, a wafer 3 can be extruded to a wafer receipts-and-payments section side, and the wafer breakage which results from wafer 3 periphery remaining eating into the slot slot 6 as for this can be prevented certainly.

[0032] Moreover, if a motor 702 is driven, since interlocking to the slot slot 6 of the wafer cassette 4 of wafer 3 periphery etc. can be canceled automatically and it can extrude to a wafer receipts-and-payments section side, the stable activity which does not have wafer breakage in the case of wafer conveyance is realizable by incorporating such a wafer extruder style 7 into a wafer conveyance process.

(Gestalt of the 2nd operation) Although three push pins 707, 708, and 709 have been arranged with the gestalt of the 1st operation according to the physical relationship which touches the periphery of a wafer 3 so that only the same amount may extrude a wafer 3 and can do it wherever the cage hula location of a wafer 3 might be located within the wafer cassette 4 Depending on a process, the cage hula location of the wafer 3 in the wafer cassette 4 has aligned, or the case of the notch instead of a cage hula exists like a 8 inch wafer.

[0033] So, the gestalt of this 2nd operation shows the wafer transport device optimal in such a case. Drawing 5 shows the outline configuration of the 2nd of the gestalt of operation of this invention, and gives the same sign to the same part as drawing 1.

[0034] In this case, the wafer extruder style 7 which counters the push actuation hole 401 of wafer cassette 4 rear face, and is prepared arranges one push pin 710 to the subbase 705 prepared in the base 701 movable through the direct-acting guide 704. When not contacting a cage hula to the location of 3' in a wafer 3, this push pin 710 extrudes a wafer 3, and has come to be able to do it to the location of 3", when the contact to wafer 3 periphery in the wafer cassette 4 is attained so that the wafer 3 of the wafer cassette 4 may be extruded straightly and may be made, and the push pin 710 contacts the cage hula of a wafer 3.

[0035] Thus, even if constituted, after it detected the conveyance wafer 3 in the wafer cassette 4 and only the constant rate has increased the cassette base 2 by the elevator device section 1 If the wafer extruder style 7 is started, a motor 702 is rotated and the disc-like cam 703 which was made to carry out eccentricity to a revolving shaft 7021, and was prepared is rotated through a cam follower 706, the subbase 705 resists the hauling force of a spring 7061, and carries out straight-line migration along with the direct-acting guide 704 in the actuation hole 401 direction of wafer cassette 4 rear face -- having -- ***** -- the push pin 710 on the subbase 705 is pressed against wafer 3 periphery like. Even if the periphery of a wafer 3 is eating into the slot slot 6 of the wafer cassette 4 by this, it is canceled of the slot slot 6 and a wafer 3 can be extruded to a wafer receipts-and-payments section side.

[0036] In this case, when the push pin 710 contacts the cage hula of a wafer 3, a wafer 3 is extruded to the location of 3', and when not contacting a cage hula, a wafer 3 will be extruded to the location of 3".

[0037] Therefore, even if such, the same effectiveness as the gestalt of the 1st operation is expectable, and further, compared with the gestalt of the 1st operation, a processing part and components mark can be lessened and can be made in cost and advantageous.

(Gestalt of the 3rd operation) With the gestalt of the 1st and the 2nd operation, although he is trying to extrude one wafer 3 in the wafer cassette 4 at a time, in other test equipment, the elevator device section 1 may not be formed, but the conveyance arm 5 may move up and down to serve also as the elevator device section 1, and a wafer 3 may be extracted.

[0038] So, the gestalt of this 3rd operation shows the optimal wafer transport device for such equipment. Drawing 6 (a) and (b) show the outline configuration of the 3rd of the gestalt of operation of this invention, and give the same sign to the same part as drawing 1.

[0039] In this case, the wafer extruder style 8 which counters the push actuation hole 401 of wafer cassette 4 rear face, and is prepared has stood straight and formed the column 802 in the base 801. And the direct-acting guides 803 and 803

were formed in the vertical location of this column 802, respectively, and the subbase 804 is formed free [an attitude] to the push actuation hole 401 of wafer cassette 4 rear face through these direct-acting guides 803 and 803.

[0040] The wafer was carried out to the edge corresponding to wafer cassette 4 rear face of the subbase 804, and the pin 805 is formed in it. A wafer is carried out and a pin 805 moves in this direction that intersects perpendicularly to wafer cassette 4 front face in the wafer cassette 4 which extrudes a wafer 3 straightly and can do it in a package altogether by advance to the push actuation hole 401 direction of wafer cassette 4 rear face of the subbase 804.

[0041] In this case, sufficient stroke which minded the subbase 804 by the direct-acting guides 803 and 803 and which extrudes certainly and is possible even if the successive range of a pin 805 has the cage hula location of a wafer 3 in which location in the wafer cassette 4 by carrying out a wafer is secured, and it has not come to extrude a wafer 3 too much with the stopper which is not illustrated.

[0042] The spring 806 is formed between the subbase 804 and a column 802. This spring 806 is for always retreating the position in readiness which opened the subbase 804 from the push actuation hole 401 of wafer cassette 4 rear face. Moreover, when the subbase 804 is pulled by the spring 806, the subbase 804 and the direct-acting guide 803 fall out with the stopper which is not illustrated.

[0043] In addition, 807 is a handle for being attached in the subbase 804 and carrying out advance migration of the subbase 804 in the push actuation hole 401 direction of wafer cassette 4 rear face.

[0044] In such a configuration, if the wafer cassette 4 resists the hauling force of a spring 806 in the subbase 804 on the cassette base 2 by an operator doing push actuation of the handle 807 from an installation **** condition and makes it move forward in the push actuation hole 401 direction of wafer cassette 4 rear face, a wafer will be carried out and a pin 805 will be pressed against coincidence in all wafer 3 peripheries in the wafer cassette 4 with advance of the subbase 804. Even if the wafer 3 which is eating into the slot slot 6 of the wafer cassette 4 exists by this, these wafers 3 are also canceled of the slot slot 6, and can be extruded to a wafer receipts-and-payments section side.

[0045] Moreover, if push actuation of a handle 807 is canceled of this condition, the subbase 804 will retreat with a spring 806 to the position in readiness opened from the push actuation hole 401 of wafer cassette 4 rear face.

[0046] If it does in this way, therefore, the wafer extruder style 8 Since a wafer is carried out by push actuation of the handle 807 by the operator and it was made to carry out advance migration of the pin 805 Since can simplify the whole wafer extruder style 8 configuration further, it can do advantageously in cost, and a wafer is carried out further, and all the wafers 3 in the wafer cassette 4 are put in block by advance migration, and a pin 805 is extruded and is made, a tact time can also be shortened.

[0047]

[Translation done.]

* NOTICES *

JPO and NCIPI are not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] Drawing showing the outline configuration of the 1st of the gestalt of operation of this invention.

[Drawing 2] Drawing showing the outline configuration of the wafer extruder style used for the gestalt of the 1st operation.

[Drawing 3] Drawing showing the outline configuration of the push pin used for the wafer extruder style of the gestalt of the 1st operation.

[Drawing 4] The flow chart for explaining actuation of the gestalt of the 1st operation.

[Drawing 5] Drawing showing the outline configuration of the 2nd of the gestalt of operation of this invention.

[Drawing 6] Drawing showing the outline configuration of the 3rd of the gestalt of operation of this invention.

[Drawing 7] Drawing showing the conventional whole wafer transport device.

[Drawing 8] Drawing for explaining the slot slot of a wafer cassette, and the relation of a wafer.

[Description of Notations]

1 -- Elevator device section,

2 -- Cassette base,

3 -- Wafer,

4 -- Wafer cassette,

401 -- Push actuation hole,

5 -- Conveyance arm,

6 -- Slot slot,

601 -- Surroundings lump section,

7 -- Wafer extruder style,

701 -- Base,

702 -- Motor,

7021 -- Revolving shaft,

703 -- Cam,

704 -- Direct-acting guide,

705 -- Subbase,

706 -- Cam follower,

7061 -- Spring,

707, 708, 709, 710 -- Push pin,

8 -- Wafer extruder style,

801 -- Base,

802 -- Column,

803 -- Direct-acting guide,

804 -- Subbase,

805 -- A wafer is carried out and it is a pin,

806 -- Spring,

807 -- Handle.

[Translation done.]

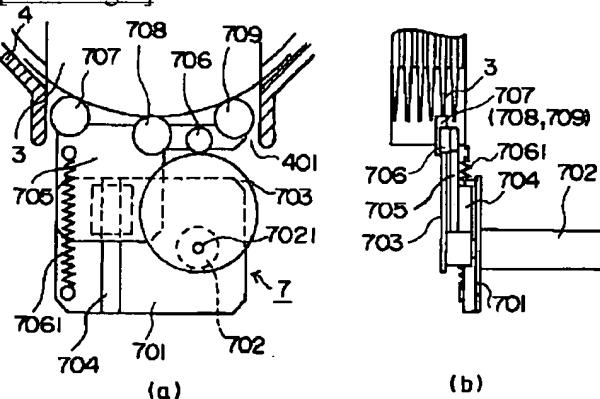
* NOTICES *

JPO and NCIPI are not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DRAWINGS

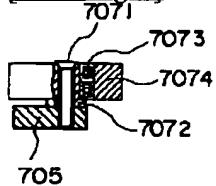
[Drawing 2]



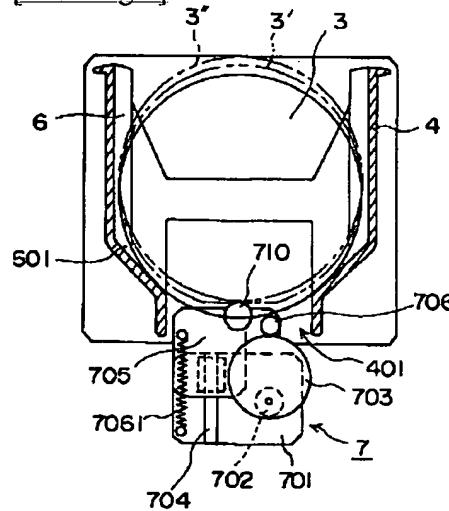
(a)

(b)

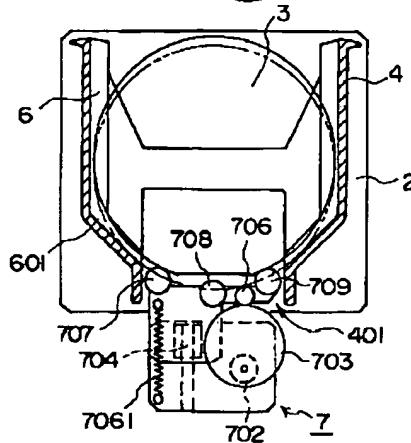
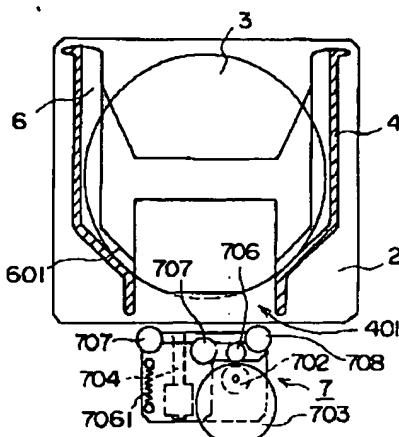
[Drawing 3]



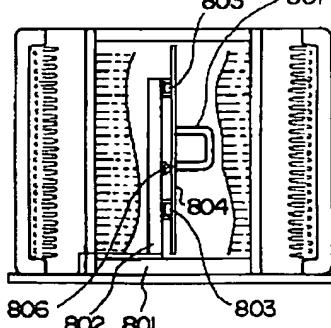
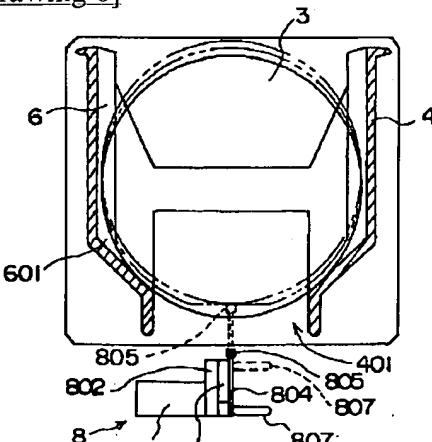
[Drawing 5]



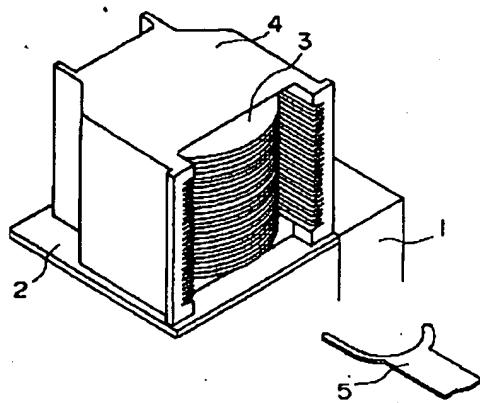
[Drawing 1]



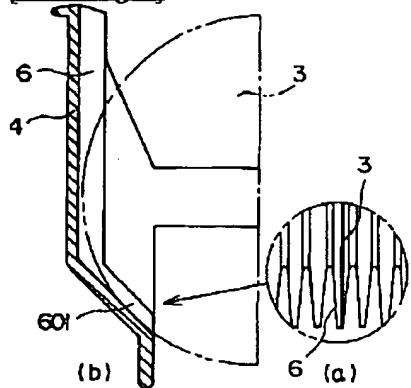
[Drawing 6]



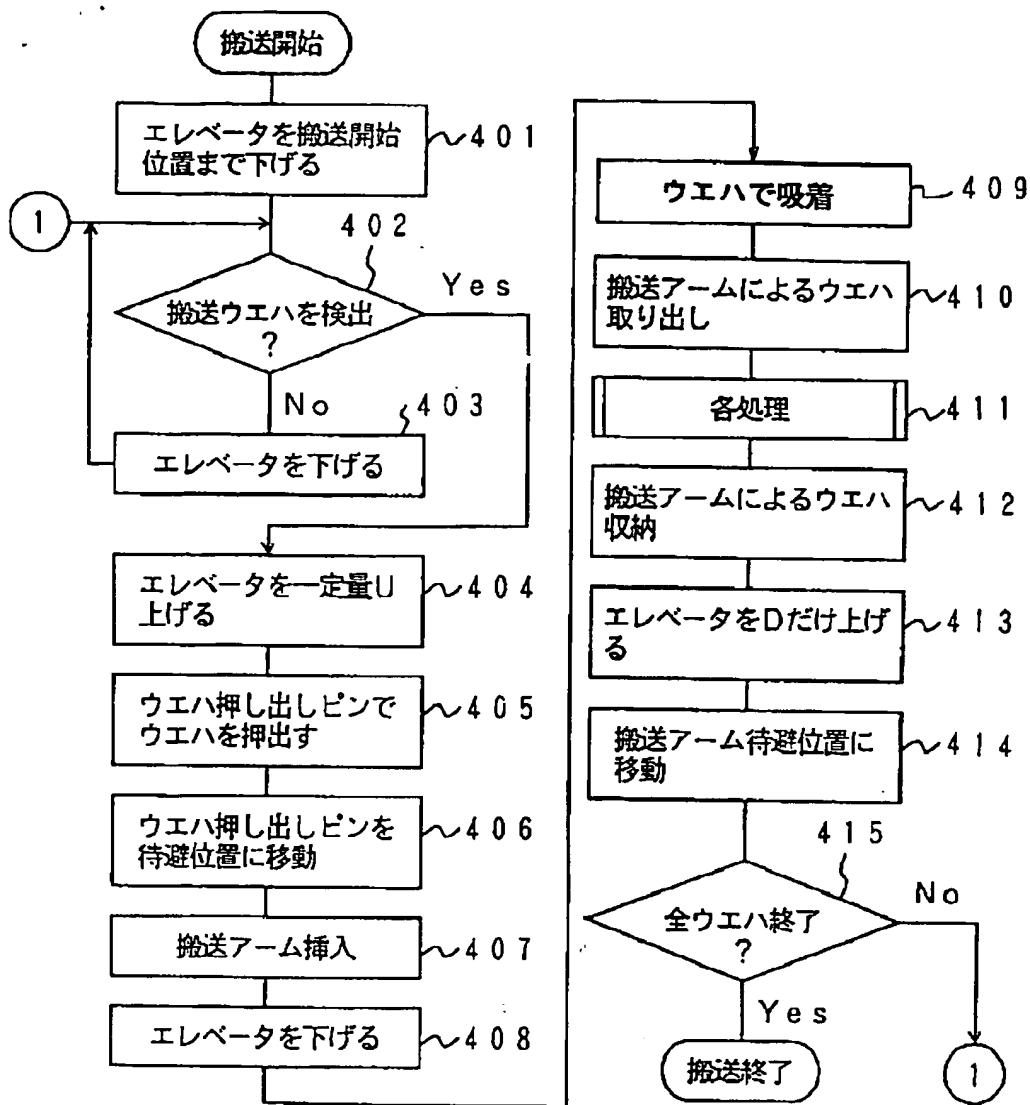
[Drawing 7]



[Drawing 8]



[Drawing 4]



[Translation done.]